



(19)

Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 631 998 B1

(12)

EUROPEAN PATENT SPECIFICATION

- (45) Date of publication and mention
of the grant of the patent:
22.09.1999 Bulletin 1999/38

(51) Int. Cl.⁸: C04B 38/02, C04B 38/06

- (21) Application number: 94304607.8

- (22) Date of filing: 24.06.1994

(54) Functional ceramics

Funktionskeramiken

Céramiques fonctionnelles

- (84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL
PT SE

- (30) Priority: 25.06.1993 JP 20439193

- (43) Date of publication of application:
04.01.1995 Bulletin 1995/01

- (73) Proprietor: Higa, Teruo
Ginowan-shi, Okinawa-ken (JP)

- (72) Inventor: Higa, Teruo
Ginowan-shi, Okinawa-ken (JP)

- (74) Representative:
Lewin, John Harvey
Elkington and Fife,
Prospect House,
8 Pembroke Road
Sevenoaks, Kent TN13 1XR (GB)

- (56) References cited:
DE-C- 304 854

- PROCEEDINGS OF THE INTERNATIONAL
CONFERENCE ON SCIENCE ON CERAMICS,
vol. 14, 1988 LONDON GB, pages 113-118, H.
KROMER ET AL 'REFINEMENT AND
ENRICHMENT OF CLAY AND KAOLIN RAW
MATERIALS BY DRESSING METHODS'
- CHEMICAL ABSTRACTS, vol. 106, no. 18, 4 May
1987 Columbus, Ohio, US; abstract no. 142624n,
page 274; & TR. INST. MOSK. KHIM.-TEKHNOL.
INST. IM D.I. MENDELEEVA, vol. 137, 1985
MOSCOW UDSSR, pages 66-72, V.V. BARANOV
ET AL

Remarks:

The file contains technical information submitted
after the application was filed and not included in
this specification

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 0 631 998 B1

Description

[0001] The present invention relates to a functional ceramic having a wide variety of biological activities and a process for preparing the same.

Related Art

[0002] Ceramics possessing biological activities are known in the art.

[0003] For instance, functional ceramics provided with activities by controlling the internal physical structure, by calcining with materials having catalytic functions, or by adsorbing microbes or catalysts into the pores of porous ceramics have been proposed.

[0004] However, most of the conventional functional ceramics, in general, have a single activity to be aimed. Further, the activity is sometimes insufficient and may be lost with the passage of time. Particularly, the ceramics provided with the activity by adsorbing microorganisms or catalysis, further improvements are desired in some points. For instance, in the ceramics the density of microorganisms may vary with the lapse of time. Moreover, the activity of ceramics may not be stable, unless environmental conditions, such as pH or temperature are maintained constant.

[0005] DE-C-304854 discloses a process for preparation of porous articles from an inorganic composition, in which yeast or similar organisms are added to produce gas, giving rise to porosity. The porous products may be used as casting moulds, in filter materials or as catalyst carriers.

[0006] Proceedings of the International Conference on Science on Ceramics, Volume 14, 1988, Pages 113-118, relates to methods of treating clay and kaolin raw materials, using certain fungi and bacteria. Only one microorganism at a time is used. The effects of these microorganisms on the iron content and plasticity of clays is discussed.

[0007] Chemical Abstracts, Volume 106, No. 18, 1987, Abstract No. 142624n, relates to treatment of ceramic slips with *Bacillus mucilaginosus*. This is said to improve the bending strength of tiles after firing and to decrease the water absorption.

SUMMARY OF THE INVENTION

[0008] An object of the present invention is to provide a functional ceramic which possesses a wide variety of activities and which is stable and can be used for a long period of time.

[0009] The present invention provides a ceramic obtainable by calcining a composition comprising raw ceramic materials and a plurality of microorganisms and/or culture fluid thereof, wherein the microorganisms are selected from each of the following five groups: actinomycetes, phototrophic bacteria, lactic acid bacteria, mold fungi and yeast, and wherein the ceramic contains an antioxidation material derived from the microorganisms.

[0010] The present invention also provides a process for preparing a ceramic, comprising calcining a ceramic material with a plurality of microorganisms and/or culture fluid thereof, wherein the microorganisms are selected from each of the following five groups:

actinomycetes, phototrophic bacteria, lactic acid bacteria, mold fungi and yeast.

DETAILED DESCRIPTION OF THE INVENTION

Ceramic

[0011] The functional ceramic according to the present invention are obtainable by calcining composition raw ceramic materials and a plurality of microorganisms and/or a culture thereof.

[0012] The microorganism employed in the present invention is capable of producing an antioxidation material. The term "antioxidation material" herein means a material suppressing the oxidation of iron or a material decomposing or resolving an active oxygen. The antioxidation material includes, for examples, a variety of organic acids, amino acids and proteins.

[0013] Preferable specific examples of the microorganisms include:

the microorganisms belonging to actinomycetes include those belonging to genera *Streptomyces*, *Streptovorticillum*, *Nocardia*, *Micromonospora* and *Rhodococcus*. Specific examples of actinomycetes include *Streptomyces albus* (e.g. ATCC 3004), *Streptovorticillum baldeccii* (e.g. ATCC 23854), *Nocardia asteroides* (e.g. ATCC 19247), *Micromonospora chalybea* (e.g. ATCC 12452) and *Rhodococcus rhodochrous* (e.g. ATCC 1380); the microorganisms belonging to photosynthetic bacteria include those belonging to genera *Rhodospseudomonas*, *Rhodospirillum*, *Chromatium* and *Chlorobium*. Specific examples of photosynthetic bacteria include *Rhodospseudomonas*

domonias sphaeroides (e.g. IFO 12203), *Rhodospirillum rubrum* (e.g. IFO 3986), *Chromatium okenii* and *Chlorobium limicola*;

the microorganisms belonging to lactic acid bacteria include those belonging to genera *Lactobacillus*, *Propionibacterium*, *Pediococcus* and *Streptococcus*. Specific examples of lactic acid include *Lactobacillus bulgaricus* (e.g. ATCC 11842), *Propionibacterium freudenreichii* (e.g. IFO 12391), *Pediococcus halophilus* (e.g. IFO 12172), *Streptococcus lactis* (e.g. IFO 12007) and *Streptococcus faecalis* (e.g. IFO 3971);

the microorganisms belonging to mold fungi include those belonging to genera *Aspergillus* and *Mucor*. Specific examples of mold fungi include *Aspergillus japonicus* (e.g. IFO 4060), *Aspergillus oryzae* (e.g. IFO 4075) and *Mucor hiemalis* (e.g. IFO 5303); and

the microorganisms belonging to yeast include those belonging to genera *Saccharomyces* and *Candida*. Specific examples of yeast include *Saccharomyces cerevisiae* (e.g. IFO 0304), *Saccharomyces lactis* (e.g. IFO 0433) and *Candida utilis* (e.g. IFO 0396).

[0014] According to the present invention, a plurality of the microorganisms are employed. The microorganisms are selected from each of five groups of actinomycetes, phototrophic bacteria, lactic acid bacteria, mold fungi and yeast.

[0015] These microorganisms may be cultured under the conventional culture condition of microorganisms.

[0016] The microorganisms and/or culture products thereof (the term "culture fluid" will mean hereinafter the microorganism and/or culture products thereof) are added to raw ceramic materials, which are then calcined to give ceramic.

[0017] The raw ceramic materials herein means materials which can be calcined to produce ceramic and includes those usually used in the production of ceramics. Specific examples of the raw ceramic materials include clay, zeolite, bekuhen-seki and the other materials of porcelains such as kaolin, gainome-clay, kibushi-clay, pottery stone, feldspar. These ceramic materials may be used alone or as a mixture of the two or more. In view of the physical properties, such as strength, of ceramic to be finally obtained, the raw ceramic materials are preferably those of which the components are controlled.

[0018] Preferable specific examples of the clay include Akatsu-gainome-clay (Aichi, Japan, Silicate: 50.14%, Titanium oxide: 0.50%, Alumina: 34.70%, Iron oxide: 1.36%, Lime: 0.24%, Magnesia: 0.10%, Potassium oxide: 0.58%, Sodium oxide: 0.30%), Tokikuchi-gainome-clay (Gifu, Japan, Silicate: 47.51%, Titanium oxide: 0.46%, Alumina: 36.60%, Iron oxide: 1.24%, Lime: 0.22%, Magnesia: 0.21%, Potassium oxide: 0.60%, Sodium oxide: 0.04%), Shimagahara-gainome-clay (Mie, Japan, Silicate: 48.14%, Titanium oxide: 1.03%, Alumina: 35.01%, Iron oxide: 1.17%, Lime: 0.54%, Magnesia: 0.29%, Potassium oxide: 0.44%, Sodium oxide: 0.40%), Motoyama-kibushi-clay (Aichi, Japan, Silicate: 45.48%, Titanium oxide: 0.62%, Alumina: 32.15%, Iron oxide: 0.74%, Lime: 0.29%, Magnesia: 0.24%, Potassium oxide: 0.54%, Sodium oxide: 0.19%), Hara-kibushi-clay (Gifu, Japan, Silicate: 51.88%, Alumina: 33.07%, Iron oxide: 1.83%, Lime: 0.42%, Magnesia: 0.25%, Potassium oxide: 0.92%, Sodium oxide: 0.17%), and Shimagahara-kibushi-clay (Mie, Japan, Silicate: 49.78%, Titanium oxide: 0.90%, Alumina: 29.74%, Iron oxide: 2.07%, Lime: 0.24%, Magnesia: 0.03%, Potassium oxide: 0.23%, Sodium oxide: 0.36%, Water: 15.76%).

[0019] The ceramic materials are preferably dried beforehand and passed through a screen so that the materials has an appropriate range of the particle size distribution.

[0020] The amount of the culture fluid to be added to the raw ceramic material are preferably in the range of 25 to 40% by weight.

[0021] The culture fluid and the ceramic material and, if necessary, a binder as well as a variety of additives are added simultaneously or in an appropriate sequence, and blended satisfactorily with an appropriate mixing means.

[0022] The blend thus obtained is next molded. The shape of the ceramic according to the present invention is not particularly limited and may be made adapted to various applications described hereunder.

[0023] The blend thus molded is preferably dried and calcined.

[0024] Calcination temperature of the blend is preferably in the range of 700 to 1300°C, particularly 700 to 1050°C. The blend is preferably calcined for 4 to 15 hours. After the calcination, the ceramic are cooled to give the functional ceramic according to the present invention.

Use of ceramic

[0025] The ceramic according to the present invention have a wide variety of biological activities. Without intending to be bound by theory, it is believed that something derived from the microorganisms remains in the ceramic and provides biological activities with ceramic even after the calcination.

[0026] The ceramic according to the present invention has an activity of improving the soil. Therefore, according to another aspect of the present invention, there provides a composition for improving the soil comprising the ceramic of the present invention as an active ingredient. There also provides a method for improving the soil comprising the step of applying the ceramic of the present invention to the soil. According to the preferred embodiment of the present invention, the ceramic which is in the form of particles may apply the soil. The amount of the ceramic applied is preferably in

the range of 25 to 100g per 1m² of the soil.

[0027] Further, the ceramic according to the present invention has an activity of improving water quality or decomposing sewage or sludge, i.e., an aqueous solution. Therefore, according to a further aspect of the present invention, there provides a composition for improving water quality or decomposing sewage or sludge comprising the ceramic of the present invention as an active ingredient. There also provides a method for improving water quality or decomposing sewage or sludge comprising the step of bringing the ceramic of the present invention into contact with sewage or sludge. When used for improving water quality or decomposing sewage or sludge, the ceramic of the present invention, preferably in the form of particles, may be spread over the bottom of a container in which waste water are contained or may be put in a bag and immersed in the container. Alternatively, a fine powdery ceramic of the present invention may be coated on a surface of the container.

[0028] The ceramic of the present invention also has an activity of deodorizing an odor. Therefore, according to another aspect of the present invention, there provides a composition for deodorizing the odor comprising the ceramic of the present invention as an active ingredient. There also provides a method for deodorizing the odor comprising the step of bringing the ceramic of the present invention in contact with the source of the odor. According to the preferred embodiment of the present invention, the amount of the ceramic used for the deodorization is preferably in the range of 1 to 15g/kg of the source of the odor such as garbage and wastes. Alternatively, it is also possible to prepare a bag having an activity of deodorizing the odor. The bag may be prepared by blending the powdery functional ceramic with paper manufacturing materials or plastic materials, preparing paper or plastic film with the paper materials or plastic materials, and preparing a bag made of the paper or the plastic film thus obtained.

[0029] The ceramic of the present invention has an activity of improving fuels, such as gasoline. Therefore, according to another aspect of the present invention, there provides a composition for improving the fuel comprising the ceramic of the present invention as an active ingredient. There also provides a method for improving the fuel comprising the step of bringing the fuel into contact with the ceramic of the present invention.

[0030] The ceramic of the present invention has an activity of reducing harmful component levels in an exhaust gas. Therefore, according to a further aspect of the present invention, there provides a composition for treating the exhaust gas to reduce harmful component levels in the exhaust gas, comprising the ceramic of the present invention as an active ingredient. There also provides a method for cleaning up the exhaust gas comprising the step of bring the exhaust gas into contact with the ceramic of the present invention. According to the preferred embodiment of the present invention, the ceramic of the present invention may be put in an exhaust pipe of a car or motorcycle.

[0031] The invention is illustrated in more detail by reference to the following examples.

Example 1: Preparation of ceramic

[0032] Each of the culture fluids of *Streptomyces albus* (ATCC 3004), *Streptovirgillum baldacii* (ATCC 23654), *Nocardia asteroides* (ATCC 19247), *Micromonospora chalybea* (ATCC 12452), *Rhodopseudomonas sphaeroides* (IFO 12203), *Rhodospirillum rubrum* (IFO 3986), *Lactobacillus bulgaricus* (IFO 3986), *Propionibacterium freudenreichii* (IFO 12391), *Pediococcus halophilus* (IFO 12172), *Streptococcus lactis* (IFO 12007), *Streptococcus faecalis* (IFO 3971), *Aspergillus japonicus* (IFO 4060), *Aspergillus oryzae* (IFO 4075), *Mucor hiemalis* (IFO 5303), *Saccharomyces cerevisiae* (IFO 0304), *Saccharomyces lactis* (IFO 0433), *Candida utilis* (IFO 0396) cultured in 4% molasses solution was prepared and blended in an amount of 20 - 35% by weight with Gaimome-day. The blend was sufficiently kneaded, formed into particles. The particles were dried and calcined at 700°C for 6 hours to give ceramic particles (particle diameter: 2 - 3 mm).

Comparative Example: Ceramic without fluid of microorganisms

[0033] Ceramic particles were prepared in the same manner as that of Example 1 except that the culture fluid of the microorganism was not added.

Example 2: Improvement of soil

[0034] The particles of the ceramic obtained in Example 1 was applied in an amount of 50 g per 1 m² of the soil. Then, spinach, SANTOSAI (a greenstuff), and chibout were cultured. Results are shown in Table 1. Culture in the soil with the ceramic of the present invention brought about the increased harvest in 10 to 20% or more as compared with the harvest in the soil without the ceramic.

Table 1

Effect of functional ceramic on harvests of vegetables				
Product	Treated Area		Non-treated Area	
	Height (cm)	Harvest/m ² (kg)	Height (cm)	Harvest/m ² (kg)
Spinach	35	4.5	33	3.8
SANTOSAI	32	4.6	30	4.0
Chiboul	45	5.4	43	4.6

Example 3: Water quality improvement (1)

[0035] The ceramic particles obtained in Example 1 were spread with a thickness of about 1 cm over the bottom of a 50 liter container in which waste water (BOD, 280 ppm; SS, 120 ppm) was contained. The change in the water quality of the waste water was observed. Also, the change in the water quality was observed in the case that the ceramic obtained in Comparative Example were spread. The results are shown in Table 2.

Table 2

Water quality improvement							
Ceramic		Before treatment	After				
			1day	3days	5days	7days	9days
Example 1	BOD	280	75	20	5	3	3
	SS	120	50	10	4	4	2
Comparative Example	BOD	280	230	200	183	151	140
	SS	120	110	98	81	64	60

BOD: Biological Oxygen Demand (ppm),
SS: Suspended Substance (ppm).

Example 4: Water quality improvement (2)

[0036] The ceramic particles obtained in Example 1 were processed in the form of powder. A concrete bath which was not cured was prepared. The powder was coated on the surface of the bath. And then, the bath was cured. The concrete bath was filled with waste water. Changes in water quality was observed. The results are shown in Table 3.

Table 3

Purification of water							
Ceramic		Before treatment	After				
			1day	3days	5days	7days	9days
Example 1	BOD		50	43	21	13	6
	SS		10	7	5	34	2
Comparative Example	BOD		50	48	45	44	41
	SS		10	9	9	8	7

BOD: Biological Oxygen Demand (ppm),
SS: Suspended Substance (ppm).

Example 5: Water quality improvement (3)

[0037] The ceramic particles obtained in Example 1 were charged as a filter in a filtering apparatus having a capacity of 300 liter/hour. Waste water used in Example 3 was introduced into the filtering apparatus. The change in the quality of the filtrate was observed.

[0038] Filtration was conducted in the same manner as the above with the ceramic obtained in Comparative Example to observe the change in the quality of filtrate.

[0039] The results are shown in Table 4.

Table 4

Purification of water					
Ceramic		Before treatment		After	
			2 hours	4 hours	6 hours
Example 1	BOD	280	5	1	0.01
	SS	120	0.5	0	0
Comparative Example	BOD	280	140	100	51
	SS	120	25	21	18

BOD: Biological Oxygen Demand (ppm).

SS: Suspended Substance (ppm).

Example 6: Deodorization (1)

[0040] The ceramic particles obtained in Example 1 or Comparative Example was applied in an amount of 3 g to 1 kg of garbage from households. The garbage was sealed and left to stand for 10 days. Then, concentrations of ammonia and hydrogen sulfide as the sources of unpleasant odor were measured. The results are shown in Table 5.

Table 5

Deodorization (1)				
Ceramic	Ammonia (ppm)	Hydrogen sulfide (ppm)	Methylmercaptan (ppm)	Trimethylamine (ppm)
Example 1	N.D.	N.D.	N.D.	N.D.
Comparative Example	4.4	2.81	0.051	0.131

N.D.: Non-detected.

Example 7: Deodorization (2)

[0041] The ceramic particles obtained in Example 1 were processed into powder and blended into paper manufacturing materials. Then, a paper bag was prepared from the paper manufacturing material. The paper bag was filled with garbage from households, sealed and left to stand for 10 days. Then, concentrations of the sources of the unpleasant odor such as ammonia or hydrogen sulfide were measured.

[0042] The results are shown in Table 6.

Deodorization (2)

Ceramic	Ammonia (ppm)	Hydrogen sulfide (ppm)	Methylmercaptan (ppm)	Trimethylamine (ppm)
Example 1	N.D.	N.D.	N.D.	N.D.
Comparative Example	4.1	2.9	0.041	0.121

N.D.: Non-detected.

Example 8: Deodorization (3)

[0043] The ceramic particles obtained in Example 1 or Comparative Example were processed into powder and blended in an amount of 10 % into nylon material. Then, a nylon bag was prepared from the nylon material. The bag was filled with garbage from a households, sealed and left to stand for 10 days. Then, concentrations of the sources of the unpleasant odor such as ammonia or hydrogen sulfide were measured.

[0044] The results are shown in Table 7.

Table 7

Deodorization				
Ceramic	Ammonia (ppm)	Hydrogen sulfide (ppm)	Methylmercaptan (ppm)	Trimethylamine (ppm)
Example 1	N.D.	N.D.	N.D.	N.D.
Comparative Example	4.4	3.3	0.045	0.135

N.D.: Non-detected.

Example 9: Decomposition of sludge

[0045] The ceramic particles obtained in Example 1 were mixed with sludge collected from the bottom of the sea. The amount of the ceramic was about 100 g into 5 liters of the sludge. The mixture was left to stand in a 10 liter clear glass bottle for 90 days. Then, the amount of sludge left in the bottle was measured.

[0046] The results are shown in Table 8.

Table 8

Ceramic	Initial (liter)	30 days (liter)	60 days (liter)	90 days (liter)
Example 1	5	4.5	3.9	3.0
Comparative Example	5	4.9	4.9	4.9

Example 10: Improving fuel

[0047] The ceramic particles obtained in Example 1 or Comparative Example were charged as a filter in a filtering apparatus having a capacity of 300 liter/hour. A commercially available gasoline was circulated through the filtering apparatus for hours. The gasoline obtained was then supplied to a car to measure the travelling distance per fuel consumption.

[0048] The results are shown in Table 9.

Table 9

Ceramic		Trial		
		1st	2nd	3rd
Example 1	Travelling distance per 40 litter	331.2 km	326 km	334 km
	Fuel expenses	8.28 km/l	8.2 km/l	8.35 km/l
Comparative Example	Travelling distance per 40 litter	228 km	288 km	288 km
	Fuel expenses	7.2 km/l	7.2 km/l	7.2 km/l

Example 11: Reduction of harmful component levels in exhaust gas

[0049] A cylindrical pipe (diameter: 10-20mm) of the ceramic of the present invention was prepared by substantially the same manner as that Example 1. The ceramic pipe thus obtained was put in an exhaust pipe of a car. The CO and HC levels in an exhaust gas was measured.

[0050] The results are shown in Table 10.

Table 10

Ceramic	CO (%)	HC (ppm)
Example 1	0.02	0.1
Comparative Example	0.4	1.3

Claims

1. A ceramic obtainable by calcining a composition comprising raw ceramic materials and a plurality of microorganisms and/or culture fluid thereof, wherein the microorganisms are selected from each of the following five groups: actinomycetes, phototrophic bacteria, lactic acid bacteria, mold fungi and yeast, and wherein the ceramic contains an antioxidant material derived from the microorganisms.

2. A ceramic according to claim 1, wherein the microorganisms are selected from each of the following groups:

actinomycetes belonging to genera Streptomyces, Streptovercillium, Nocardia, Micromonospora or Rhodococcus;

phototrophic bacteria belonging to genera Rhodospseudomonas, Rhodospirillum, Chromatium or Chlorobium;

lactic acid bacteria belonging to genera Lactobacillus, Propionibacterium or Pediococcus;

mold fungi belonging to genera Aspergillus or Mucor; and

yeast belonging to genera Saccharomyces or Candida.

3. A ceramic according to claim 2, wherein the microorganisms are selected from each of the following groups:

actinomycetes belonging to Streptomyces albus, Streptovercillium baldacii, Nocardia asteroides, Micromonospora chalybeata or Rhodococcus rhodochrous;

phototrophic bacteria belonging to Rhodospseudomonas schaeferoides, Rhodospirillum rubrum or Chlorobium limicola;

lactic acid bacteria belonging to Lactobacillus bulgaricus, Propionibacterium freudenreichii, Pediococcus helveticus, Streptococcus lactis or Streptococcus faecalis;

mold fungi belonging to Aspergillus japonicus, Aspergillus oryzae or Mucor hiemalis; and

yeast belonging to Saccharomyces cerevisiae, Saccharomyces lactis or Candida utilis.

- 5 4. A ceramic according to claim 1, wherein the ceramic material is selected from clay, zeolite, bakuhan-seki and the other materials of porcelains.

- 5 A process for preparing a ceramic, comprising calcining a ceramic material with a plurality of microorganisms and/or culture fluid thereof, wherein the microorganisms are selected from each of the following five groups:

10

actinomycetes, phototrophic bacteria, lactic acid bacteria, mold fungi and yeast.

- 6 A process for preparing a ceramic according to claim 5, wherein the microorganisms are selected from each of the following groups:

15

actinomycetes belonging to genera Streptomyces, Streptovorticillum, Nocardia, Micromonospora or Rhodococcus;

20

phototrophic bacteria belonging to genera Rhodospseudomonas, Rhodospirillum, Chromatium or Chlorobium;

lactic acid bacteria belonging to genera Lactobacillus, Propionibacterium or Pediococcus;

mold fungi belonging to genera Aspergillus or Mucor; and

25

yeast belonging to genera Saccharomyces or Candida.

7. A process for preparing a ceramic according to claim 6, wherein the microorganisms are selected from each of the following groups:

30

actinomycetes belonging to Streptomyces albus, Streptovorticillum baldacci, Nocardia asteroides, Micromonospora chazea or Rhodococcus rhodochrous;

phototrophic bacteria belonging to Rhodospseudomonas sphaeroides, Rhodospirillum rubrum, or Chlorobium limicola;

35

lactic acid bacteria belonging to Lactobacillus bulgaricus, Propionibacterium freudenreichii, Pediococcus halophilus, Streptococcus lactis or Streptococcus faecalis;

mold fungi belonging to Aspergillus japonicus, Aspergillus oryzae or Mucor hiemalis; and

yeast belonging to Saccharomyces cerevisiae, Saccharomyces lactis or Candida utilis.

8. A process for preparing a ceramic according to claim 5, wherein the ceramic material is selected from clay, zeolite, bakuhan-seki and the other materials of porcelains.

40

9. A process for preparing a ceramic according to claim 5, wherein calcination is conducted at a temperature of 700 to 1300°C.

45

10. A composition for improving the soil, comprising a ceramic according to claim 1 as an active ingredient.

11. A composition for improving water quality, comprising a ceramic according to claim 1 as an active ingredient.

12. A composition for deodorising an odor, comprising a ceramic according to claim 1 as an active ingredient.

50

13. A composition for improving fuel, comprising a ceramic according to claim 1 as an active ingredient.

14. A composition for cleaning up an exhaust gas, comprising a ceramic according to claim 1 as an active ingredient.

55

15. A process for improving the soil, comprising the step of applying a ceramic according to claim 1 to the soil.

16. A process for improving water quality, comprising the step of bringing an aqueous solution into contact with a ceramic according to claim 1.

17. A process for deodorising an odor, comprising the step of applying a ceramic according to claim 1 to the source of the odor.
18. A process for improving fuel, comprising the step of bringing the fuel into contact with a ceramic according to claim 1.
19. A process for cleaning up an exhaust gas, comprising the step of bringing the exhaust gas into contact with a ceramic according to claim 1.

Patentansprüche

1. Keramik, erhältlich durch Calcinieren einer Zusammensetzung umfassend rohe Keramikmaterialien und eine Vielzahl von Mikroorganismen und/oder Kulturflüssigkeit davon, wobei die Mikroorganismen aus jeder der folgenden fünf Gruppen ausgewählt sind: Actinomyceten, phototrophe Bakterien, Milchsäurebakterien, Schimmelpilze und Hefe, und wobei die Keramik ein Antioxidationsmaterial enthält, das von den Mikroorganismen herührt.

2. Keramik nach Anspruch 1, worin die Mikroorganismen ausgewählt sind aus jeder der folgenden Gruppen:

Actinomyceten, die zu den Gattungen Streptomyces, Streptovorticillum, Nocardia, Micromonospora oder Rhodococcus gehören;

phototrophe Bakterien, die zu den Gattungen Rhodopseudomonas, Rhodospirillum, Chromatium oder Chlorobium gehören;

Milchsäurebakterien, die zu den Gattungen Lactobacillus, Propionibacterium oder Pedococcus gehören;

Schimmelpilze, die zu den Gattungen Aspergillus oder Mucor gehören; und

Hefe, die zu den Gattungen Saccharomyces oder Candida gehört.

3. Keramik nach Anspruch 2, worin die Mikroorganismen ausgewählt sind aus jeder der folgenden Gruppen:

Actinomyceten, die zu Streptomyces albus, Streptovorticillum baldacii, Nocardia asteroides, Micromonospora chalybeata oder Rhodococcus rhodochrous gehören;

phototrophe Bakterien, die zu Rhodopseudomonas sphaeroides, Rhodospirillum rubrum oder Chlorobium limicola gehören;

Milchsäurebakterien, die zu Lactobacillus bulgaricus, Propionibacterium freudenreichii, Pedococcus halophilus, Streptococcus lactis oder Streptococcus faecalis gehören;

Schimmelpilze, die zu Aspergillus japonicus, Aspergillus oryzae oder Mucor hiemalis gehören; und

Hefe, die zu Saccharomyces cerevisiae, Saccharomyces lactis oder Candida utilis gehört.

4. Keramik nach Anspruch 1, worin das keramische Material ausgewählt ist aus Ton, Zeolith, Bakuhan-seki und den anderen Materialien von Porzellan.

5. Verfahren zum Herstellen einer Keramik, umfassend das Calcinieren eines keramischen Materials mit einer Vielzahl von Mikroorganismen und/oder Kulturflüssigkeit davon, wobei die Mikroorganismen ausgewählt sind aus jeder der folgenden fünf Gruppen:

Actinomyceten, phototrophe Bakterien, Milchsäurebakterien, Schimmelpilze und Hefe.

6. Verfahren zum Herstellen einer Keramik nach Anspruch 5, worin die Mikroorganismen ausgewählt sind aus jeder der folgenden Gruppen:

Actinomyceten, die zu den Gattungen Streptomyces, Streptovorticillum, Nocardia, Micromonospora oder Rho-

rhodococcus gehören;

phototrophe Bakterien, die zu den Gattungen Rhodospseudomonas, Rhodospirillum, Chromatium oder Chlorobium gehören;

Milchsäurebakterien, die zu den Gattungen Lactobacillus, Propionibacterium oder Pediococcus gehören;

Schimmelpilze, die zu den Gattungen Aspergillus oder Mucor gehören; und

Hefe, die zu den Gattungen Saccharomyces oder Candida gehört.

7. Verfahren zum Herstellen einer Keramik nach Anspruch 6, worin die Mikroorganismen ausgewählt sind aus jeder der folgenden Gruppen:

Actinomyceten, die zu Streptomyces albus, Streptovorticillum baldacii, Nocardia asteroides, Micromonospora chalybeata oder Rhodococcus rhodochrous gehören;

phototrophe Bakterien, die zu Rhodospseudomonas sphaeroides, Rhodospirillum rubrum oder Chlorobium limicola gehören;

Milchsäurebakterien, die zu Lactobacillus bulgaricus, Propionibacterium freudenreichii, Pediococcus halophilus, Streptococcus lactis oder Streptococcus faecalis gehören;

Schimmelpilze, die zu Aspergillus japonicus, Aspergillus oryzae oder Mucor hiemalis gehören; und

Hefe, die zu Saccharomyces cerevisiae, Saccharomyces lactis oder Candida utilis gehört.

8. Verfahren zum Herstellen einer Keramik nach Anspruch 5, worin das keramische Material ausgewählt ist aus Ton, Zeolith, Bakuhan-ek und den anderen Materialien von Porzellan.

9. Verfahren zum Herstellen einer Keramik nach Anspruch 5, worin die Calcinierung bei einer Temperatur von 700 bis 1300°C erfolgt.

10. Zusammensetzung zum Verbessern des Bodens, umfassend eine Keramik nach Anspruch 1 als Wirkstoff.

11. Zusammensetzung zum Verbessern der Wasserqualität, umfassend eine Keramik nach Anspruch 1 als Wirkstoff.

12. Zusammensetzung zum Desodorieren eines Geruchs, umfassend eine Keramik nach Anspruch 1 als Wirkstoff.

13. Zusammensetzung zum Verbessern von Kraftstoff, umfassend eine Keramik nach Anspruch 1 als Wirkstoff.

14. Zusammensetzung zum Reinigen eines Abgases, umfassend eine Keramik nach Anspruch 1 als Wirkstoff.

15. Verfahren zum Verbessern des Bodens, umfassend den Schritt des Auftragens einer Keramik nach Anspruch 1 auf den Boden.

16. Verfahren zum Verbessern der Wasserqualität, umfassend den Schritt des Inkontaktbringens einer wässrigen Lösung mit einer Keramik nach Anspruch 1.

17. Verfahren zum Desodorieren eines Geruchs, umfassend den Schritt des Anwendens einer Keramik nach Anspruch 1 auf die Geruchsquelle.

18. Verfahren zum Verbessern von Kraftstoff, umfassend den Schritt des Inkontaktbringens des Kraftstoffs mit einer Keramik nach Anspruch 1.

19. Verfahren zum Reinigen eines Abgases, umfassend den Schritt des Inkontaktbringens des Abgases mit einer Keramik nach Anspruch 1.

Revendications

1. Céramique pouvant être obtenue en calcinant une composition comprenant des matières de céramiques brutes et une pluralité de microorganismes et/ou un de leurs fluides de culture, dans laquelle les microorganismes sont choisis dans chacun des cinq groupes suivants : les actinomycètes, les bactéries phototrophiques, les bactéries d'acide lactique, les champignons de moisissure et la levure, et dans laquelle la céramique contient une matière d'anti-oxydation dérivée des microorganismes.

2. Céramique selon la revendication 1, dans laquelle les microorganismes sont choisis dans chacun des groupes suivants :

- ♦ les actinomycètes appartenant aux genres *Streptomyces*, *Streptoverticillium*, *Nocardia*, *Micromonospora* ou *Rhodococcus* ;
- ♦ les bactéries phototrophiques appartenant aux genres *Rhodospseudomonas*, *Rhodospirillum*, *Chromatium* ou *Chlorobium* ;
- ♦ les bactéries d'acide lactique appartenant aux genres *Lactobacillus*, *Propionibacterium* ou *Pediococcus* ;
- ♦ les champignons de moisissure appartenant aux genres *Aspergillus* ou *Mucor* ; et
- ♦ la levure appartenant aux genres *Saccharomyces* ou *Candida*.

3. Céramique selon la revendication 2, dans laquelle les microorganismes sont choisis dans chacun des groupes suivants :

- ♦ les actinomycètes appartenant à *Streptomyces albus*, *Streptoverticillium baldacii*, *Nocardia asteroides*, *Micromonospora chalybea* ou *Rhodococcus rhodochrous* ;
- ♦ les bactéries phototrophiques appartenant à *Rhodospseudomonas sphaeroides*, *Rhodospirillum rubrum* ou *Chlorobium limicola* ;
- ♦ les bactéries d'acide lactique appartenant à *Lactobacillus bulgaricus*, *Propionibacterium freudenreichii*, *Pediococcus halophilus*, *Streptococcus lactis* ou *Streptococcus faecalis* ;
- ♦ les champignons de moisissure appartenant à *Aspergillus leonicus*, *Aspergillus oryzae* ou *Mucor hiemalis* ; et
- ♦ la levure appartenant à *Saccharomyces cerevisiae*, *Saccharomyces lactis* ou *Candida utilis*.

4. Céramique selon la revendication 1, dans laquelle la matière de céramique est choisie parmi l'argile, le zéolite, bakuhari-seki et les autres matières de porcelaines.

5. Procédé pour préparer une céramique, consistant à calciner une matière de céramique avec une pluralité de microorganismes et/ou leur fluide de culture, dans lequel les microorganismes sont choisis dans chacun des cinq groupes suivants :

- ♦ les actinomycètes, les bactéries phototrophiques, les bactéries d'acide lactique, les champignons de moisissure et la levure.

6. Procédé pour préparer une céramique selon la revendication 5, dans lequel les microorganismes sont choisis dans chacun des groupes suivants :

- ♦ les actinomycètes appartenant aux genres *Streptomyces*, *Streptoverticillium*, *Nocardia*, *Micromonospora* ou *Rhodococcus* ;
- ♦ les bactéries phototrophiques appartenant aux genres *Rhodospseudomonas*, *Rhodospirillum*, *Chromatium* ou *Chlorobium* ;
- ♦ les bactéries d'acide lactique appartenant aux genres *Lactobacillus*, *Propionibacterium* ou *Pediococcus* ;
- ♦ les champignons de moisissure appartenant aux genres *Aspergillus* ou *Mucor* ; et
- ♦ la levure appartenant aux genres *Saccharomyces* ou *Candida*.

7. Procédé pour préparer une céramique selon la revendication 6, dans lequel les microorganismes sont choisis dans chacun des groupes suivants :

- ♦ les actinomycètes appartenant à *Streptomyces albus*, *Streptoverticillium baldacii*, *Nocardia asteroides*, *Micromonospora chalybea* ou *Rhodococcus rhodochrous* ;
- ♦ les bactéries phototrophiques appartenant à *Rhodospseudomonas sphaeroides*, *Rhodospirillum rubrum* ou

Chlorobium limicola ;

- ♦ les bactéries d'acide lactique appartenant à Lactobacillus bulgaricus, Propionibacterium freudenreichii, Pediococcus halophilus, Streptococcus lactis ou Streptococcus faecalis ;
- ♦ les champignons de moisissure appartenant à Aspergillus japonicus, Aspergillus oryzae ou mucor Hiemalis ; et
- ♦ la levure appartient à Saccharomyces Cerevisiae, Saccharomyces lactis ; ou Candida utilis.

8. Procédé pour préparer une céramique selon la revendication 5, dans lequel la matière de céramique est choisie parmi l'argile, la zéolite, bokuhan-seki et les autres matières de porcelaines.

9. Procédé pour préparer une céramique selon la revendication 5, dans lequel la calcination est conduite à une température de 700 à 1 300°C.

10. Composition pour améliorer le sol, comprenant une céramique selon la revendication 1 en tant qu'ingrédient actif.

11. Composition pour améliorer la qualité de l'eau, comprenant une céramique selon la revendication 1 en tant qu'ingrédient actif.

12. Composition pour désodoriser une odeur, comprenant une céramique selon la revendication 1 en tant qu'ingrédient actif.

13. Composition pour améliorer un carburant, comprenant une céramique selon la revendication 1 en tant qu'ingrédient actif.

14. Composition pour nettoyer un gaz d'échappement, comprenant une céramique selon la revendication 1 en tant que ingrédient actif.

15. Composition pour améliorer le sol, comprenant l'étape constant à appliquer une céramique selon la revendication 1 au sol.

16. Procédé pour améliorer la qualité de l'eau, comprenant l'étape consistant à amener une solution aqueuse en contact avec une céramique selon la revendication 1.

17. Procédé pour désodoriser une odeur, comprenant l'étape consistant à appliquer une céramique selon la revendication 1 à la source de l'odeur.

18. Procédé pour améliorer un carburant, comprenant l'étape consistant à amener un carburant en contact avec une céramique selon la revendication 1.

19. Procédé pour nettoyer un gaz d'échappement, comprenant l'étape consistant à amener le gaz d'échappement en contact avec une céramique selon la revendication 1.